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a similar purpose; and Thaxter, the use of sulphur for onion smut. To Bolley we are chiefly indebted for the use of corrosive sublimate and formalin solution as remedies for potato scab, while Morse has used the fumes of formalin as a substitute.

Our pathologists seem to have been in their prime, however, when making detailed life history studies of economic fungi. The particular foes of each cultivated plant have received attention, though naturally those that are most common and destructive have had special consideration. If time permitted we should like to mention these more specifically. Each of our numerous mycologists has contributed his part to the work. Some few of these investigators have already passed to the great beyond, and others are gradually laying aside the work; many, however, are yet in their prime, while there are still more just coming into prominence. Of the last I would say that their standard of work is as high, if not higher, and their training better, than that of the older investigators, though the opportunities for original work grow less or more difficult with each year. Perhaps, however, I am mistaken, and it is only the nature of the work that changes, as indicated in letters to the writer from the late M. C. Cooke of England, who, with Ellis and Peck of this country, though not directly connected with agricultural botany, has greatly helped it by systematic work with the fungi. In conclusion permit me to quote these friendly sentiments of Cooke:

> For the past forty years and more I have had kindly correspondence and good feeling with botanists in the states, some of whom I claim as my pupils in mycology. From the time of Asa Gray, one of my first friends, I have had many. Half a century has passed me in the study of fungi, and I find as much still to learn, but I am too old now to do more than float over the surface, and confine myself to plant diseases. I note with great gratification the immense development of this branch of study on your side, which puts us to shame. Your experiment stations are fine institutions. . . . I care not who does the work, only I am delighted to see it is being done, and, between ourselves, to realize that it is being done by an English-speaking race and not by Germans or Frenchmen. To my American brethren, the mycologists, I am wishing God speed, and I care not how they beat us so long as they keep it up on a high level, clear of empiricism and worthy of the race.

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THE MINERAL PRODUCTION OF THE UNITED STATES IN 1915

THE midyear review of mining conditions reported to the Secretary of the Interior on July 1 by the Director of the United States Geological Survey is well supported by the preliminary reports for the year. The Geological Survey is making public its usual estimate of mineral production for 1915 in the form of a separate statement for each of the more important mineral products.

A review of these statements confirms Secretary Lane's comment of last July to the effect that the mining revival is in full swing. In the western states alone the metal production shows an increase in value of more than $130,000,000 over the corresponding figures for 1914; and the year's increase in output for the principal metals measured in value is more than $250,000,000. Moreover it is not unreasonable to expect that when the full returns for all mineral products are compiled they will show that 1915 was the country's most productive year in the mining industry. The total may even reach two and one half billion dollars.

In the response to bettered conditions the production figures for copper, iron and zinc show the largest increase.

The copper mines passed all records for previous years, the 1915 output having a value of $236,000,000, or $83,000,000 more than the value of the production for 1914. The statistics and estimates received place the output of blister and Lake copper at 1,365,500,000 pounds or more than 120,000,000 pounds in excess of

the largest previous production and eighteen per cent. above last year's figures. Only twice in the history of copper mining has there been a larger increase in quantity of metal produced.

The total shipments of iron ore from the mines in the United States in 1915 are estimated to have exceeded 55,000,000 gross tons, an increase over 1914 of more than 38 per cent. Based on the same price as received in 1914 this represents an increase in total value of about $27,645,000. The increase in pig iron is estimated at 6,500,000 tons, with a total increase in value of pig iron production of more than $120,000,000.

The output of zinc (spelter) made from domestic ores was larger than ever before, being about 425,000 tons, worth $120,000,000 as compared with 343,418 tons in 1914, an increase of about 82,000 tons or nearly 25 per cent. in quantity and of $85,000,000 in value. Production was increased during the latter half of the year, as the production during the first half was at the rate of 415,000 tons annually and at the rate of 436,000 tons during the last half.

The output of refined pig lead from domestic ores was about 515,000 tons, worth about $48,500,000 as compared with 512,794 tons in 1914, an increase of only 2,500 tons in quantity but of $8,500,000 or 20 per cent. in value. The production of antimonial lead was 20,550 tons as compared with 16,668 tons in 1914, an increase of 3,882 tons or 23 per cent. in quantity and an increase in value of nearly $2,000,000.

The annual preliminary estimates on the production of gold and silver in the United States, made jointly by the United States Geological Survey and the Bureau of the Mint, are not yet complete, but early figures based on reports from the mines indicate an increase in mine production over that of 1914 of over $7,000,000 in gold, principally from Colorado, California, Alaska, Montana and Idaho, and an increase in mine production of silver of fully 4,000,000 ounces, chiefly from Montana, Utah and Arizona. This increase in gold production may bring 1915 up to the record year of 1909, when the gold output of this country was nearly $100,000,000.

Quicksilver also has had its best year in 1915. The quantity increased 25 per cent. over 1914, but the value of the output more than doubled owing to the much higher prices. The estimated production was 20,681 flasks of 75 pounds each, valued, at the average price for the year—the highest in the last forty years—at $1,768,225. In value, this domestic production was the highest since 1881 and in quantity the largest since 1912.

The production of bituminous coal and anthracite in 1915 is estimated to have increased between four and five million short tons, or less than 1 per cent. The quantity of bituminous coal mined increased about 6½ million tons and that of anthracite decreased over two million short tons. Owing mainly to steady demands for export coal and for coke for steel making, the output in Pennsylvania, West Virginia, Kentucky and Alabama increased over last year, but little change is recorded in other eastern states. The region west of Ohio, including the Mississippi Valley, shows a general decrease, Colorado being the only western state to show betterment.

Connected with the coke industry was the completion during the last summer of a number of large plants for the recovery of benzol from by-product coke-oven gas. This gives the United States its first output of this material, so important as a raw material in the manufacture of high explosives and chemical dyes, and the amount of this product will be reported later.

Preliminary estimates of the total output of petroleum in the United States in 1915 indicate a slight increase over the corresponding output in 1914. It is believed that the total petroleum yield of the United States in 1915 amounted to 291,400,000 barrels, of which quantity it is also estimated that 267,400,000 barrels was marketed and 24,000,000 barrels placed in producers' field tankage during the year.

The sulphuric acid industry in 1915 presented interesting development. In spite of the abnormal demand and higher prices in the latter half of the year, much of the sulphuric acid had been contracted for or was con-

sumed in the factories where made. The estimated production indicates an increase of 6½ per cent. in the three common grades, but more than 100 per cent. in the strongest grades.

The estimate of Portland cement output in 1915 indicates shipments from the mills of 86,524,500 barrels, an increase of one tenth of one per cent. over 1914. There was a slight decrease in production and this, with the appreciable decrease in stock, indicates a more conservative trend in the industry, which in the preceding few years showed a tendency to overproduction. Prices generally averaged a few cents lower per barrel in 1915 than in 1914, although toward the end of the year prices were substantially increased, and the outlook for 1916 is brighter than for several seasons.

Perhaps the most notable item in the year's record is the stimulation of metal mining in the western states. Almost without exception the increases in production were large and in several states 1915 was the best year on record. In Arizona, which leads in copper, the output of that metal exceeded the previous record production of 1913. California continues to lead in gold and had the largest yield in thirty-two years, and with one exception in half a century. In Montana and Arizona record outputs of silver are reported and in Alaska the increased production of gold and especially copper made 1915 a much more prosperous year than even 1906 when Fairbanks and Nome were yielding their greatest returns of gold from bonanza placers.

MEDALISTS OF THE ROYAL SOCIETY

AT the anniversary meeting of the Royal Society on November 30, the president, Sir William Crookes, characterized the work of those on whom the medals of the society had been conferred as follows:

The Copley medal has been conferred upon Professor Ivan Petrovitch Pavlov, one of our most distinguished foreign members, whose researches in physiology have led to the acquisition of valuable knowledge. By a most ingeniously worked-out and original method of making fistulæ or openings to the exterior, Professor Pavlov has successfully studied the interrelation of the functions of the alimentary canal. His experiments have shown how the presence of food in one cavity controls the secretion of digestive juices into the next, and he has made many discoveries concerning the conditions which influence the secretory process, while his method has facilitated the study of the chemical changes which occur in the food as it passes through the canal. Moreover, by the method which he calls that of conditioned reflexes, Professor Pavlov has studied, from a physiological point of view, the influence of the higher brain centers upon the secretion of saliva. He has also investigated the mechanism of the muscle by which bivalves open and close their shells, and the nervous control of the heart, especially through the sympathetic nerves. His resourcefulness and skill have enabled him to make important contributions to physiological science, and his work, the true worth of which has, perhaps, not yet been rightly prized, deserves the fullest recognition.

The Royal medal given annually for physical investigations has been awarded to Sir Joseph Larmor, whose work in mathematics and physics includes a very wide range of subjects—geometry, dynamics, optics, electricity, the kinetic theory of gases, the theory of radiation and dynamical astronomy—upon all of which he has published illuminating memoirs. Possibly his chief claim to distinction is the establishment of the theory that radiant energy and intramolecular forces are due to the movements of minute electric charges. This theory is fully worked out in his treatise, "Æther and Matter." For a long time Sir Joseph Larmor acted as secretary to the Royal Society, performing the duties of the office with great success, at the same time continuing with unabated vigor original research. The offer of the Royal medal is a mark of the society's appreciation and admiration of his invaluable services to science.

The other Royal medal, for work in the biological sciences, is this year conferred upon Dr. William Halse Rivers Rivers, whose work in ethnology has contributed largely to the establishment of the subject upon a scientific basis. He was the first to use the genealogical method in ethnological investigations. His remarkable originality, combined with sound judgment, have enabled him to produce work which will rank with the best that has been done in ethnology.

All chemists will agree that the award of the Davy medal to Professor Paul Sabatier is fully justified. His lengthy researches on the use of finely divided metals as catalysts are universally known. The hydrogenation of unsaturated or-